

**WHAT IS CLAIMED IS:**

1. A wide-band dispersion controlled optical fiber, characterized in that a cut-off wavelength is substantially 1285 nm or less, dispersion values are -12 to -4 ps/nm/km in a wavelength region of substantially 1285 nm to 1330 nm and 8 to 14 ps/nm/km at substantially 1625 nm wavelength, a zero dispersion wavelength is positioned in a wavelength region below substantially 1430 nm, wherein the effective cross-section area of the optical fiber at substantially 1550 nm wavelength is less than  $75 \mu\text{m}^2$ , and wherein the difference of losses between the 1550 nm wavelength and the 1625 nm wavelength is substantially 0.03 dB/km or less.
2. The optical fiber according to claim 1, wherein the wide-band dispersion controlled optical fiber includes an internal core which has a diameter  $d_1$  and a refractive index  $n_1$ ; an external core which encloses the internal core and has a diameter  $d_2$ , the refractive index  $n_2$  of the external core gradually decreasing from  $n_1$  in the direction away from the center of the internal core; an internal clad which encloses the external core and has a diameter  $d_3$  and a refractive index  $n_3$ ; and an external clad which encloses the internal clad and has a refractive index  $n_4$ ,
3. The optical fiber according to claim 2, wherein the diameters meet with the relationships of  $0 \leq d_1/d_2 \leq 0.8$  and  $0.1 \leq d_2/d_3 \leq 0.5$  and the refractive indexes meet with the relationships of  $n_1 > n_2 \geq n_3 \geq n_4$ ,  $0.0034 \leq (n_1-n_4)/n_1 \leq 0.007$ ,  $0 \leq (n_2-n_4)/n_2 \leq$

0.0048, and  $0 \leq (n_3 - n_4)/n_3 \leq 0.0014$ .

4. The optical fiber according to claim 1, wherein the optical fiber has a dispersion slope of substantially  $0.074 \text{ ps/nm}^2/\text{km}$  or less at the zero dispersion wavelength.

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5. The optical fiber according to claim 1, wherein the optical fiber has a dispersion value of  $-9 \text{ ps/nm/km}$  or more at substantially  $1310 \text{ nm}$  wavelength.

6. The optical fiber according to claim 1, wherein the optical fiber has a loss of  
10  $0.25 \text{ dB/km}$  or less at substantially  $1625 \text{ nm}$  wavelength.

7. The optical fiber according to claim 1, wherein the optical fiber has a bending loss of  $0.05 \text{ dB}$  or less at substantially  $1550 \text{ nm}$  when it is wound 100 turns around a roller with a diameter of  $60 \text{ mm}$ .

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8. A wide-band dispersion controlled optical fiber, wherein a cut-off wavelength is  $1285 \text{ nm}$  or less, dispersion values are  $-12$  to  $-4 \text{ ps/nm/km}$  in a wavelength region of  $1285 \text{ nm}$  to  $1330 \text{ nm}$  and  $8$  to  $14 \text{ ps/nm/km}$  at  $1625 \text{ nm}$  wavelength, and the dispersion slope is  $0.074 \text{ ps/nm}^2/\text{km}$  or less at zero dispersion wavelength.

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9. The optical fiber according to claim 8, wherein the zero dispersion wavelength of the optical fiber is positioned in a wavelength region of less than  $1430 \text{ nm}$ .

10. The optical fiber according to claim 8, wherein the effective cross-section area of the optical fiber is less than  $75 \mu\text{m}^2$  at 1550 nm wavelength.

5        11. The optical fiber according to claim 8, wherein the dispersion values are -6 ps/nm/km or less at 1310 nm and 14 ps/nm/km or less at 1625 nm wavelength.

12. The optical fiber according to claim 8, wherein the optical fiber has a bending loss of 0.05 dB or less at 1550 nm when it is wound 100 turns around a roller with a  
10 diameter of 60 mm.

13. The optical fiber according to claim 8, wherein the wide-band dispersion controlled optical fiber includes an internal core which has a diameter d1 and a refractive index n1; an external core which encloses the internal core and has a diameter d2, the  
15 refractive index n2 of the external core gradually decreasing from n1 in the direction away from the center of the internal core; an internal clad which encloses the external core and has a diameter d3 and a refractive index n3; and an external clad which encloses the internal clad and has a refractive index n4,

20        14. The optical fiber according to claim 13, wherein the diameters meet with the relationships of  $0 \leq d1/d2 \leq 0.8$  and  $0.1 \leq d2/d3 \leq 0.5$  and the refractive indexes meet with the relationships of  $n1 > n2 \geq n3 \geq n4$ ,  $0.0034 \leq (n1-n4)/n1 \leq 0.007$ ,  $0 \leq (n2-n4)/n2 \leq$

0.0048, and  $0 \leq (n_3 - n_4)/n_3 \leq 0.0014$ .

15. A wide-band dispersion controlled optical fiber comprising:

an internal core;

5 an external core enclosing the internal core;

an internal clad enclosing the external core; and

an external clad enclosing the internal clad, wherein respective refractive indexes between the cores and the clads are tuned using respective diameters and distribution of refractive indexes to obtain a predetermined cut-off wavelength and

10 predetermined negative range of dispersion values in an O-band wavelength region, a predetermined dispersion value in a positive range the C-band and L-band wavelength regions, a zero dispersion wavelength positioned in a wavelength region of less than a predetermined value, and wherein a cross-section area at a predetermined wavelength is less than a predetermined value, and wherein deviation of optical loss according to

15 wavelength is below a predetermined value.

16. The optical fiber according to claim 15, wherein the cut-off wavelength is 1285 nm or less and the dispersion values are -12 to -4 ps/nm/km in a wavelength region of 1250 nm to 1330 nm and 8 to 14 ps/nm/km at 1625 nm wavelength.

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17. The optical fiber according to claim 15, wherein the zero dispersion wavelength is positioned in a wavelength region below 1430 nm.

18. The optical fiber according to claim 15, wherein the effective cross-section area at 1550 nm wavelength is less than  $75 \mu\text{m}^2$ ,
19. The optical fiber according to claim 15, wherein the deviation of optical loss  
5 according to wavelength is below a predetermined value is 0.03 dB/km or less.